HELLMUTH, OBATA + KASSABAUM

Benchmarking Environmentally Friendly Laboratories

4 Case Studies

Sustainable Design

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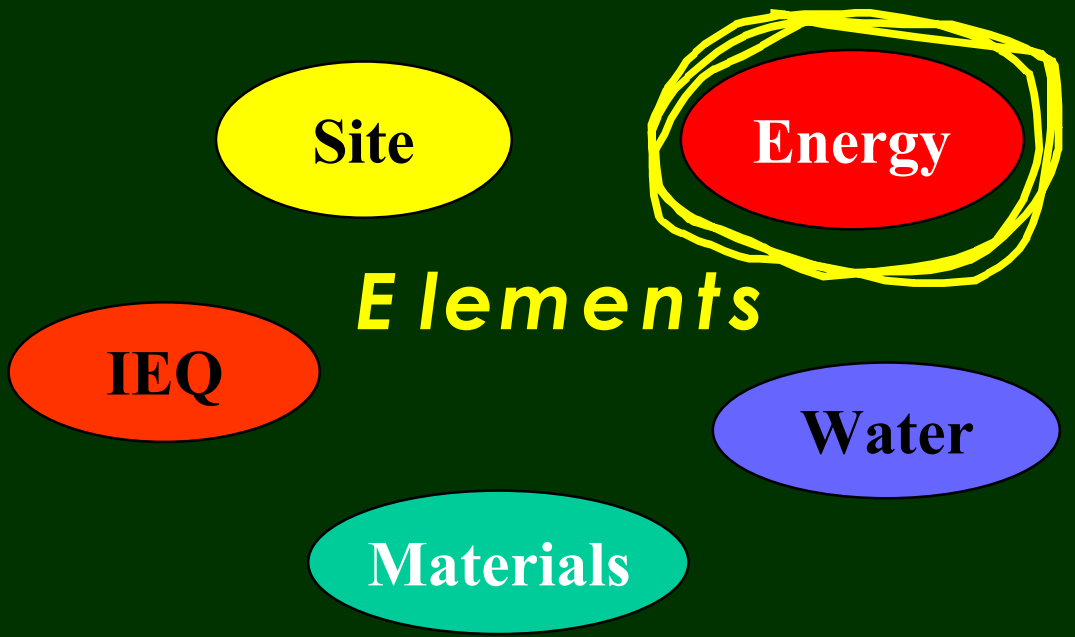
Sustainable Goals

- Protect Ecosystems
- Conserve Resources
- Improve Indoor Environmental Quality



New Research and Development Laboratories and HQ offices

- Completed 1997
- 250,000GSF lab and office
- $34 million
- $139/SF

Key Energy Strategy Components

- 3 angstrom sieve heat wheel for all exhaust
- Under floor air distribution
- Personal Environmental Controls
- Occupancy sensors on lighting and air distribution
- Maximum use of daylighting

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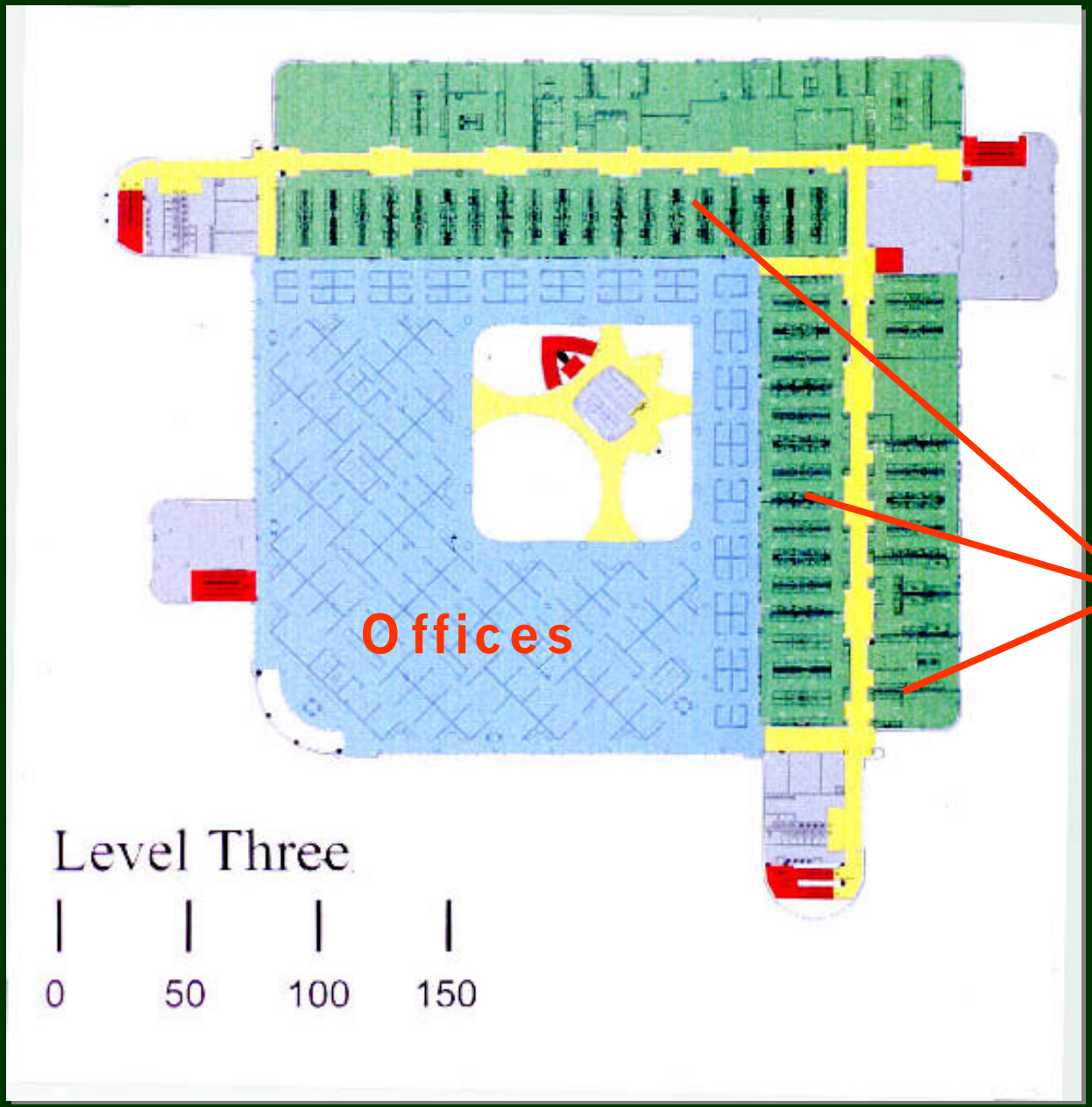

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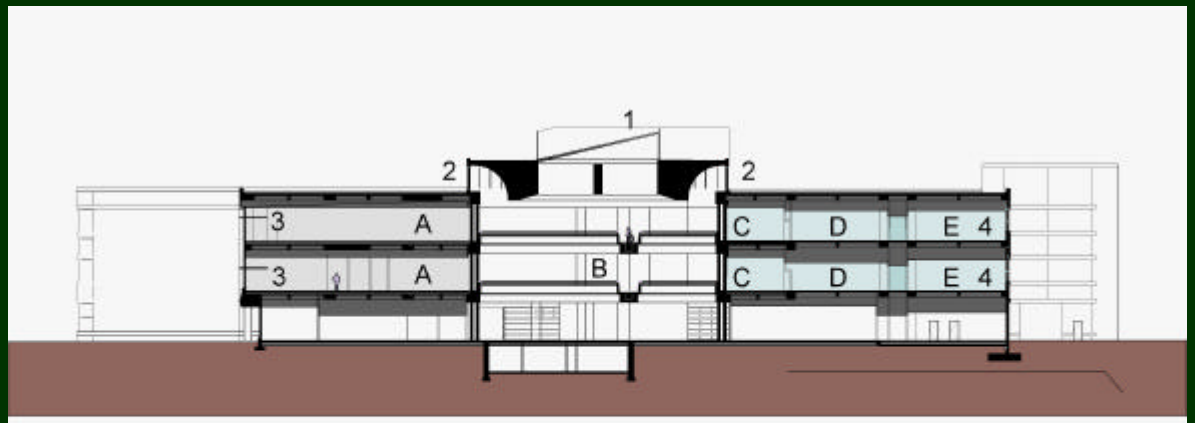

Daylighting Section

A. Open Offices
B. Atrium
C. Lab Offices
D. Labs
E. Specialty Labs

1. Skylight
2. Light Scoops
3. Light Shelves
4. Ambiant North Lighting

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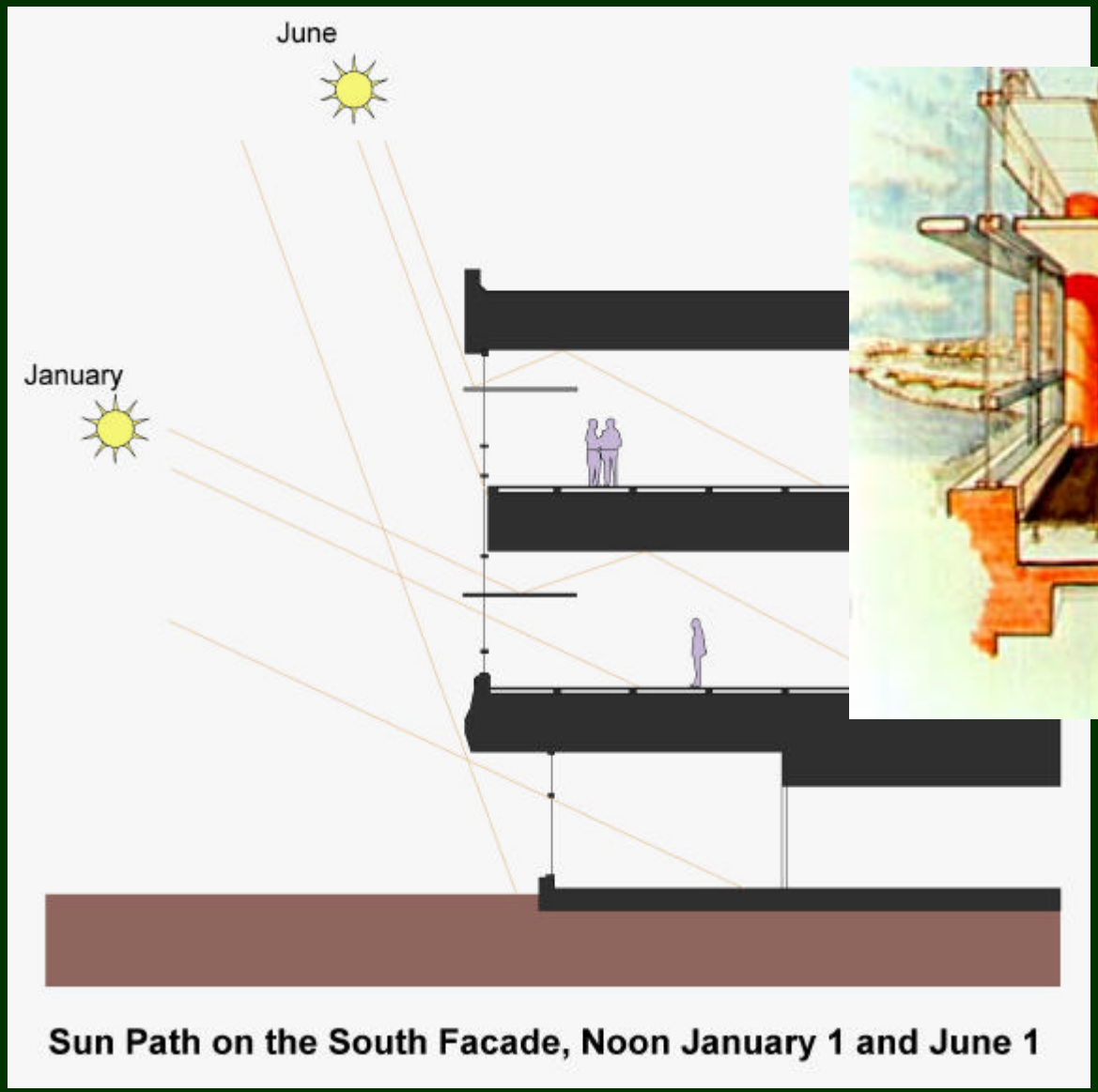
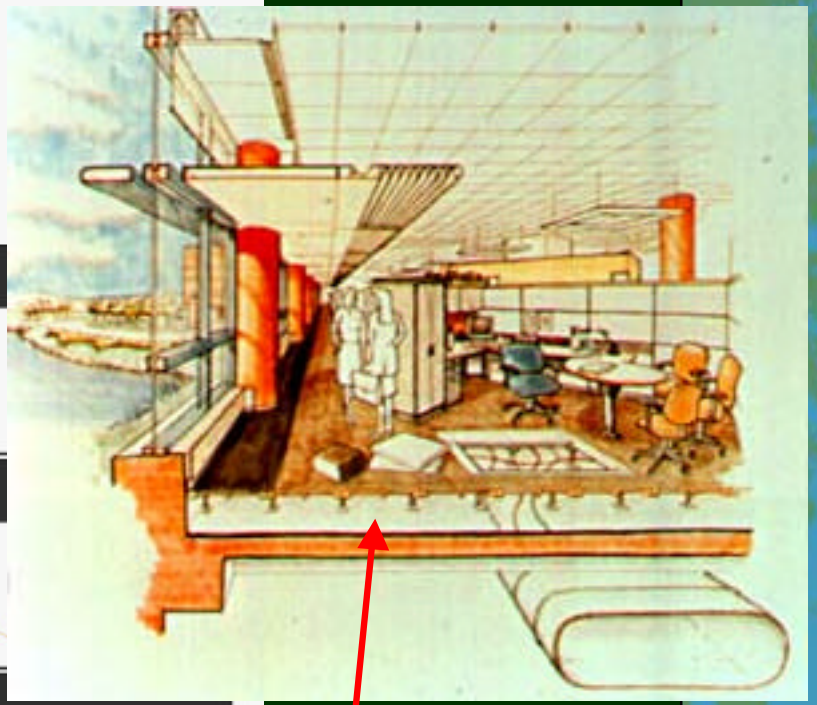
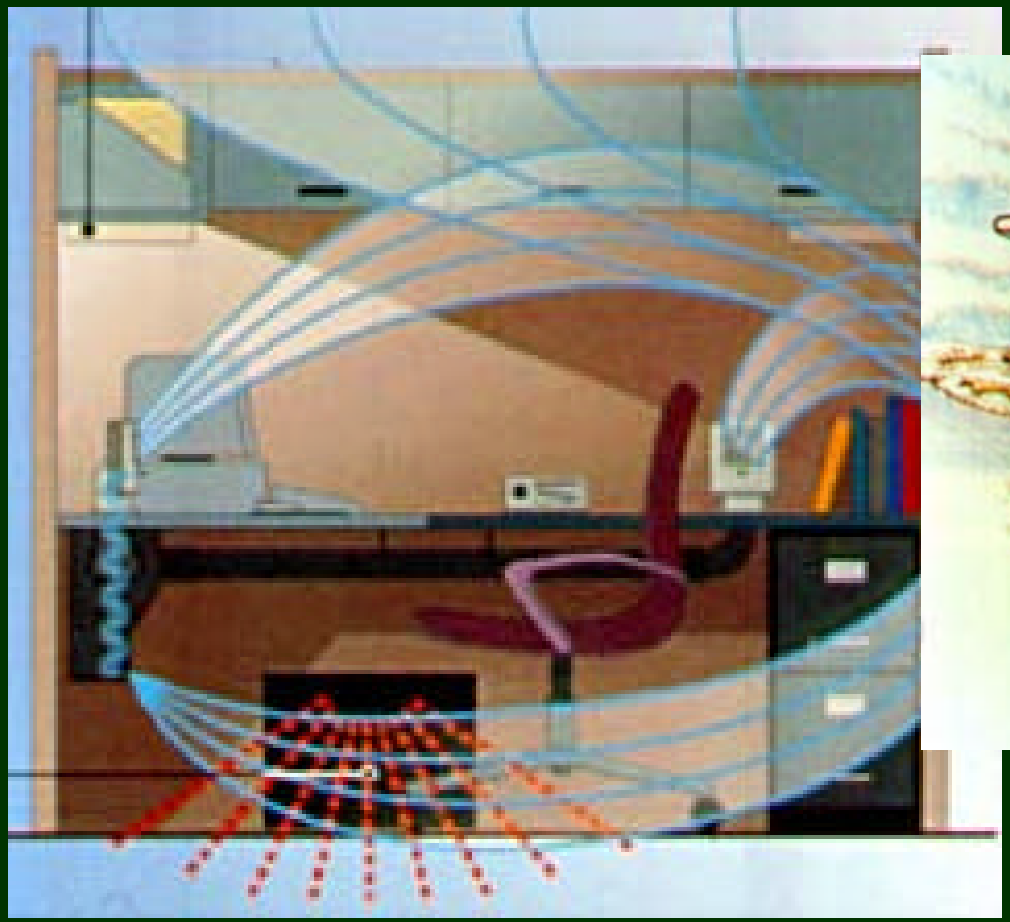
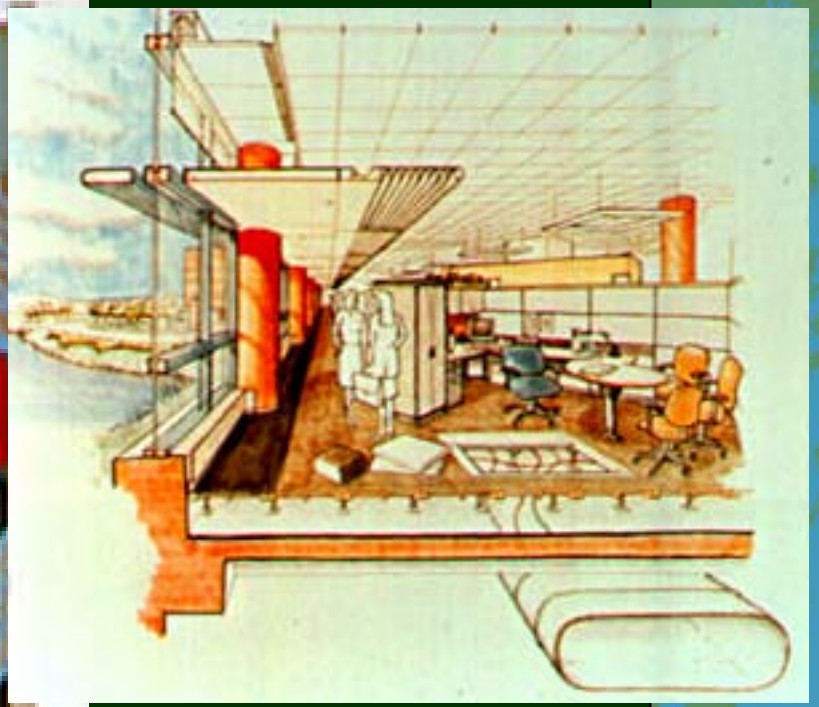


Sun Path on the South Facade, Noon January 1 and June 1



underfloor plenum





Personal Environmental System

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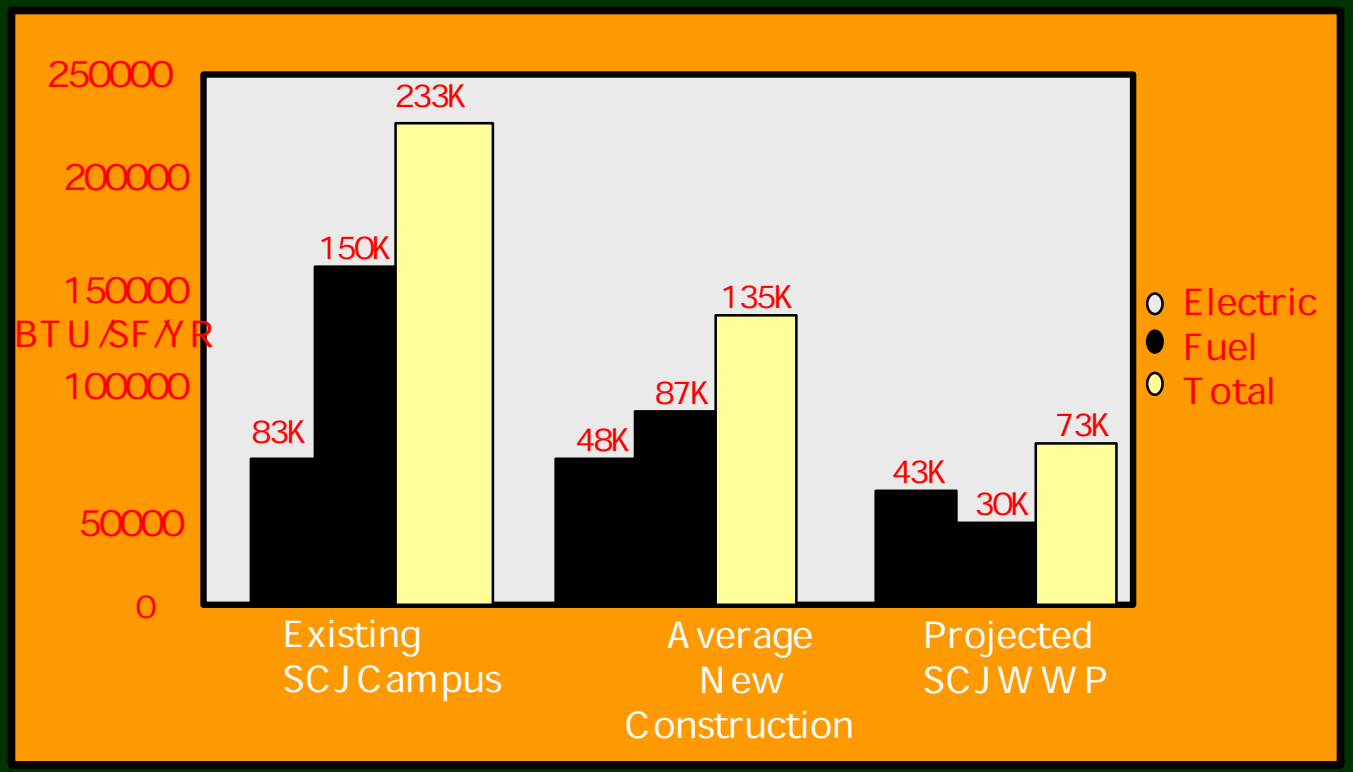
Energy Consumption



(based on 2080 hour use projection)

-Source Pace Center for Environmental Legal Studies

Energy External Costs

Annual Emissions Avoided From Energy Conservation Measures

SO_2	97 tons
NO_2	32 tons
CO_2	11, 300 tons
Particulates	7 tons
Solid Waste	600 tons

Lab/Office Construction Cost

	Cost/SF*
Excavation/Foundation	$6.86/SF
Structure	10.39/SF
Enclosure	12.51/SF
Roof	1.93/SF
Interior Construction	30.38/SF
Equipment/Furnishing	11.25/SF
Conveying System	.83/SF
Mechanical Systems	28.10/SF
Electrical Systems	19.07/SF
Sitework	9.09/SF
Total Construction Cost	$139.21/SF

* 12 /1995 cost

*includes overhead & profit

Performance Scorecard

- Energy savings +49%
- Water savings +12%
- Materials Selection A+
- IAQ A++
- Construction waste reduction 82%
- Site maintenance savings (annual) $128,000

Nidus Center

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New Incubator Laboratory

- Completed 1999
- 40,000GSF incubator lab
- $8 million
- $200/SF

Key Energy Strategy Components

- Office = 100% outside air
- Office exhaust = lab supply
- Enthalpy recovery wheel for lab exhaust
- Fume hoods exhausted seperately
- Daylighting of all spaces

Nidus Center

HELLMUTH, OBATA + KASSABAUM

- energy conservation
- water harvesting
- materials selection
- “low cost” green

Nidus Center

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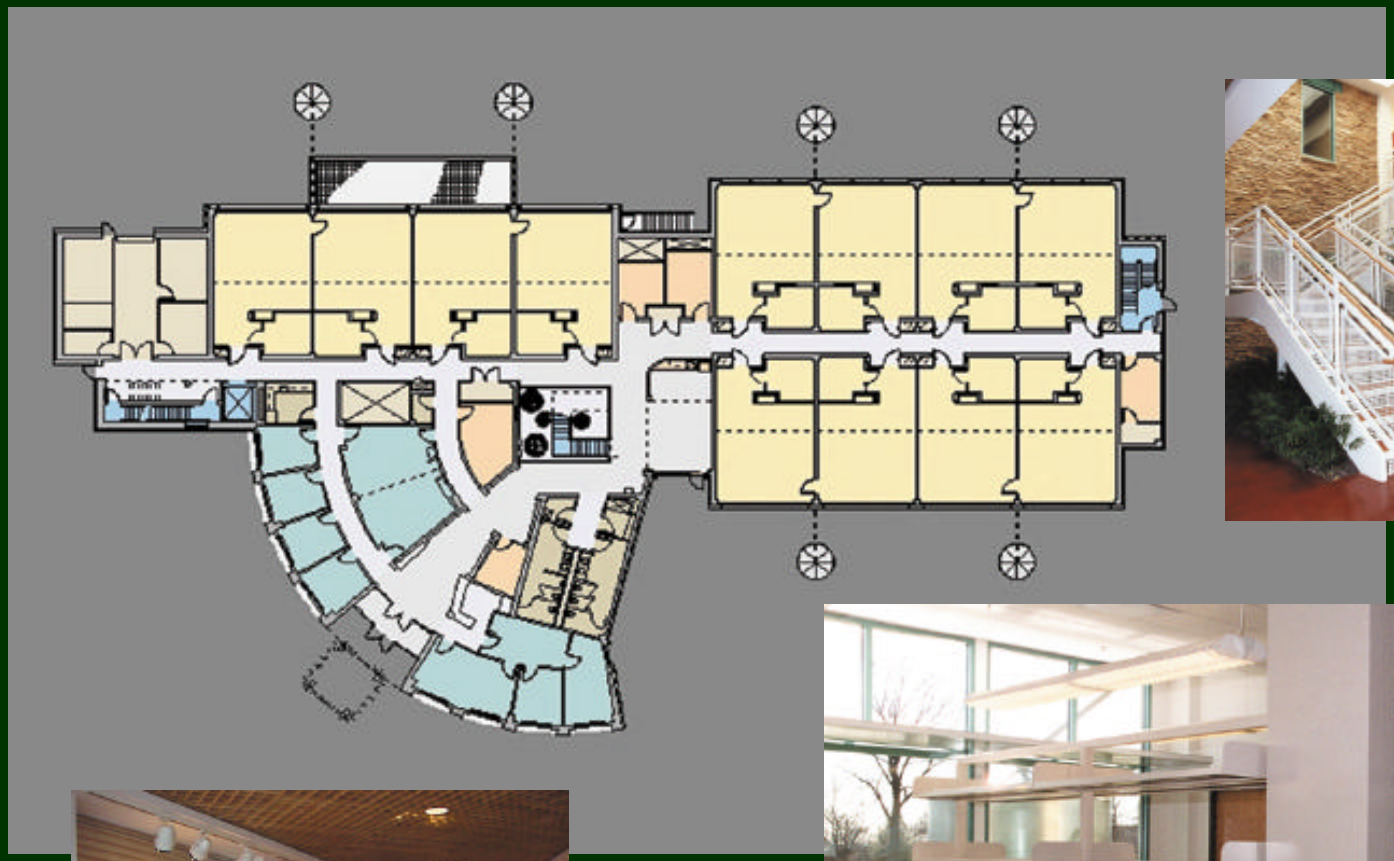

Nidus Center

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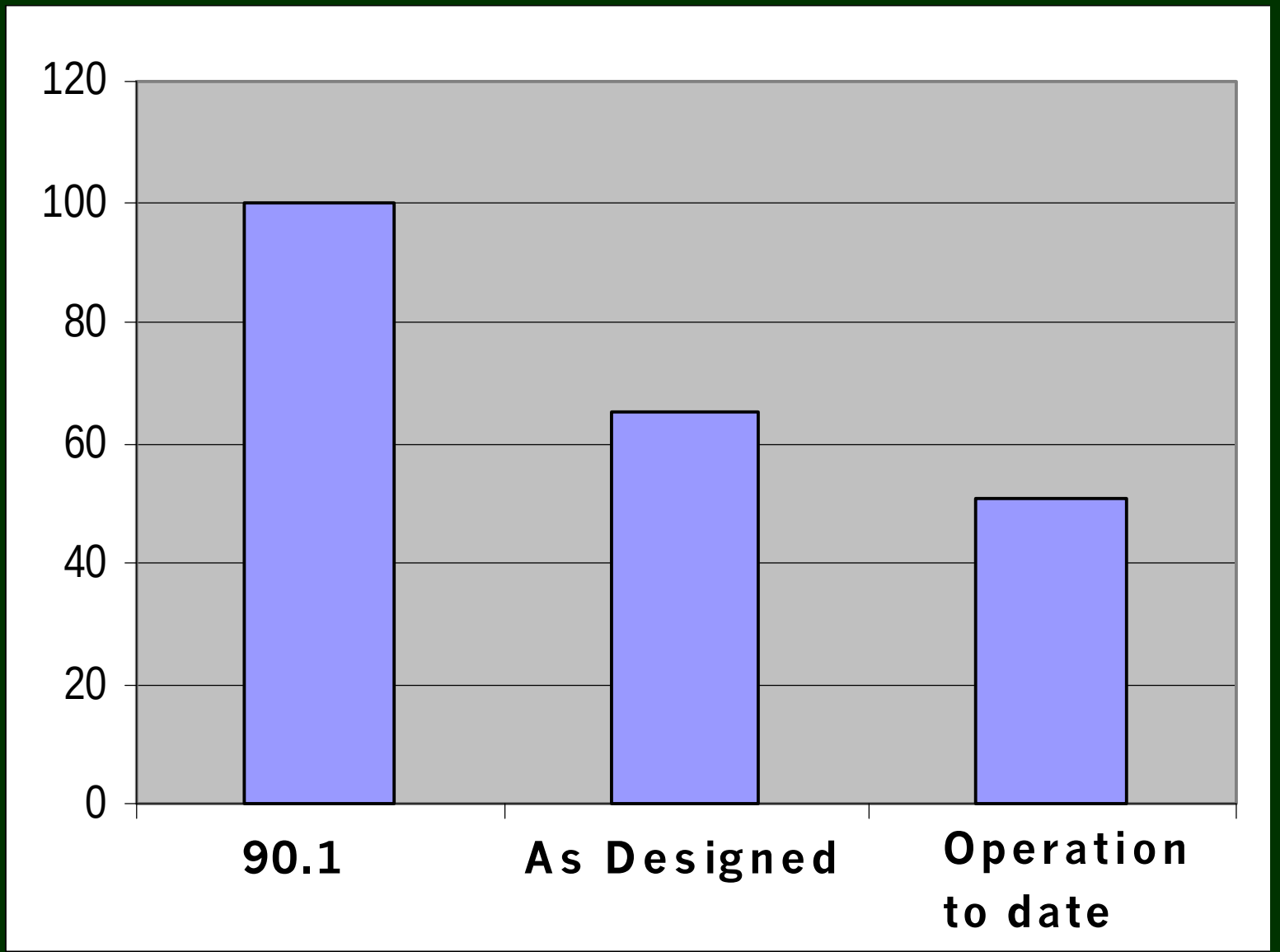


Energy Consumption

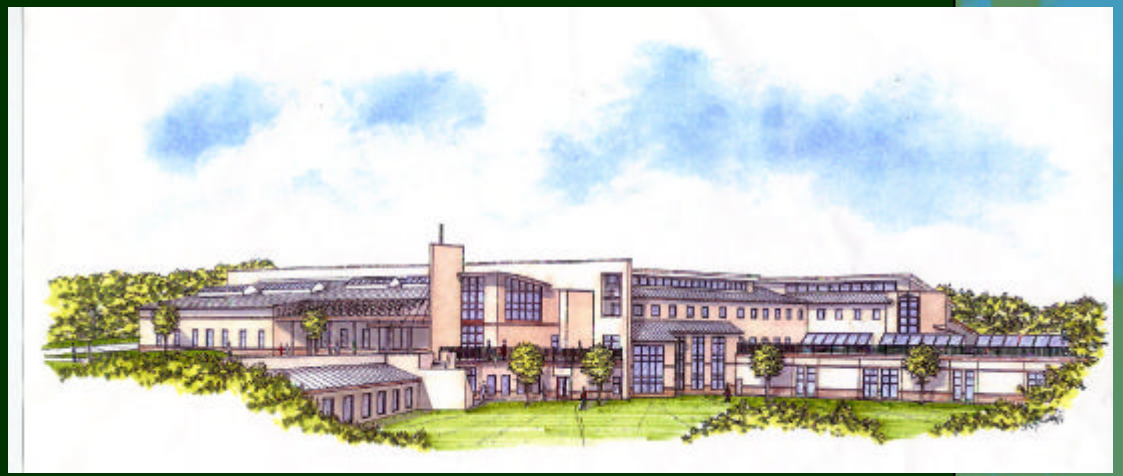
Performance Scorecard

- Energy savings +35%
- Water savings +25%
- Materials Selection A++
- IAQ A++
- Construction waste reduction 55%

LEED Certified

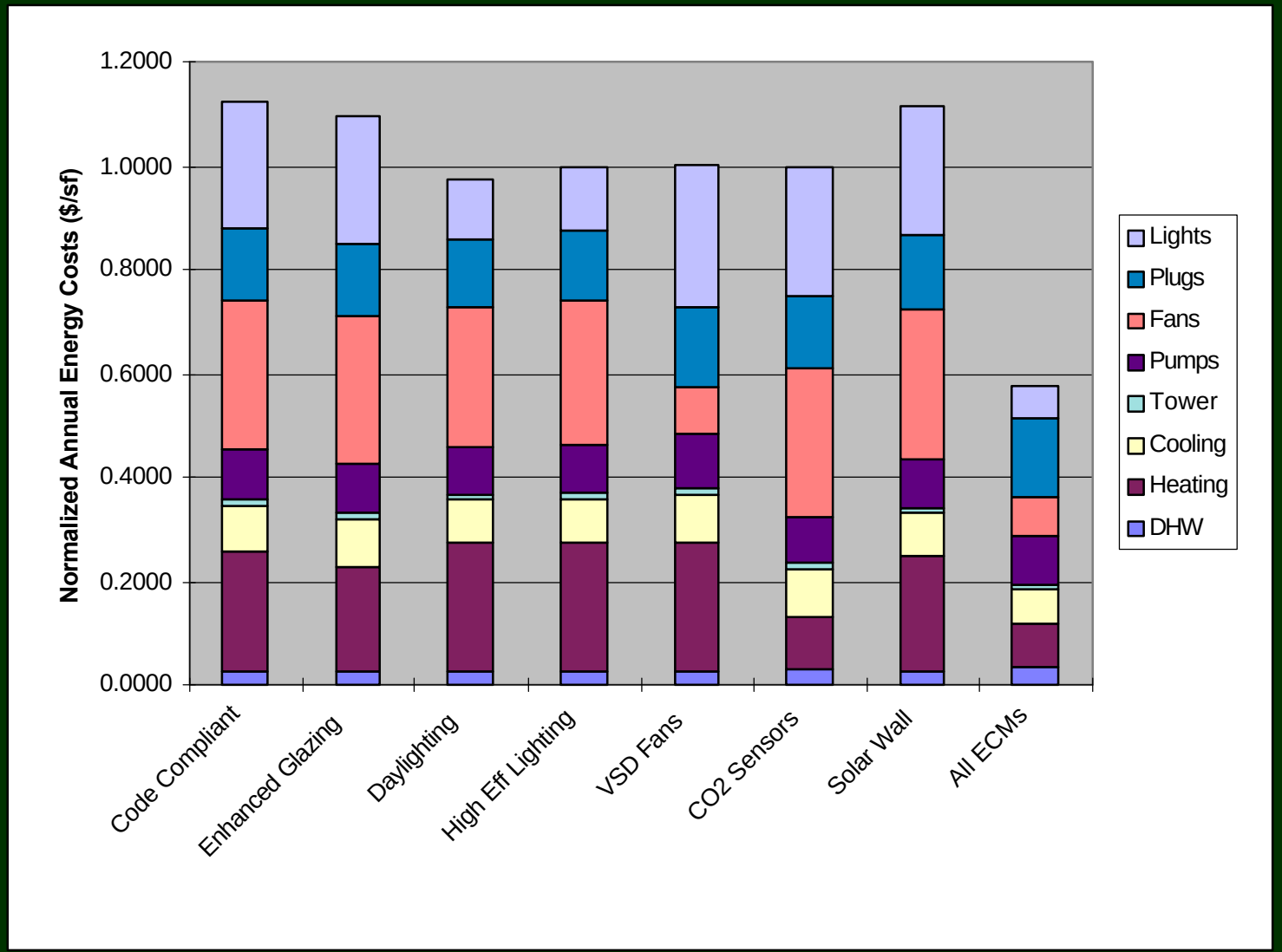
New Academic Lab and Classroom Building

- Bid October 1999
- 120,000GSF classroom and faculty office building
- $14 million
- $116/SF



Key Energy Strategy Components

- Daylighting of almost all spaces
- Occupancy sensors on lighting and air distribution
- CO2 sensors and EMS control of ventilation to large classrooms
- Preheating of outside air
- Building integrated photovoltics


Normalized Annual Energy Costs ($/sf)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
Code Compliant
Enhanced Glazing
Daylighting
High Eff Lighting
VSD Fans
CO2 Sensors
Solar Wall
All ECMs
Lights
Plugs
Fans
Pumps
Tower
Cooling
Heating
DHW

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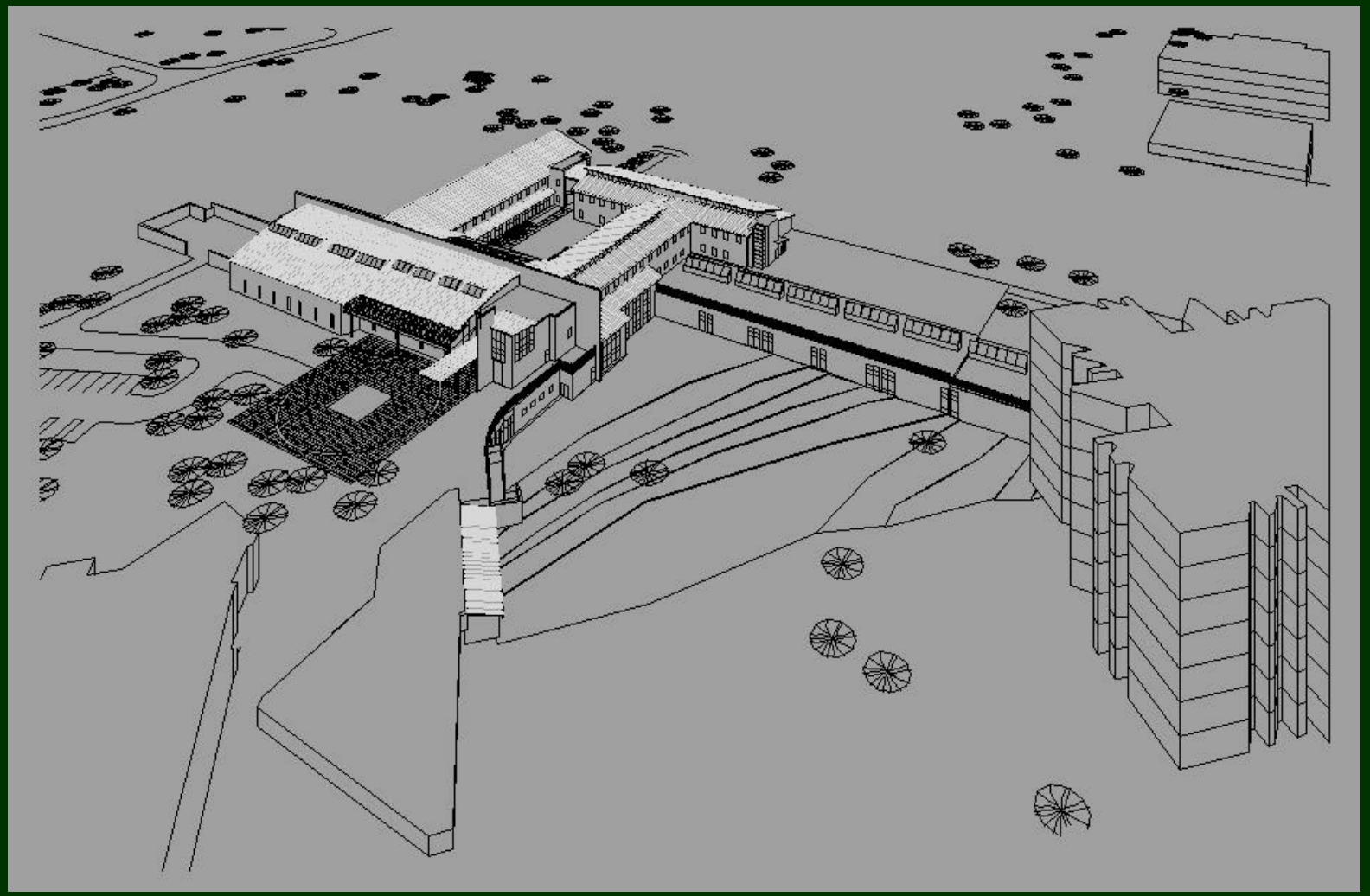

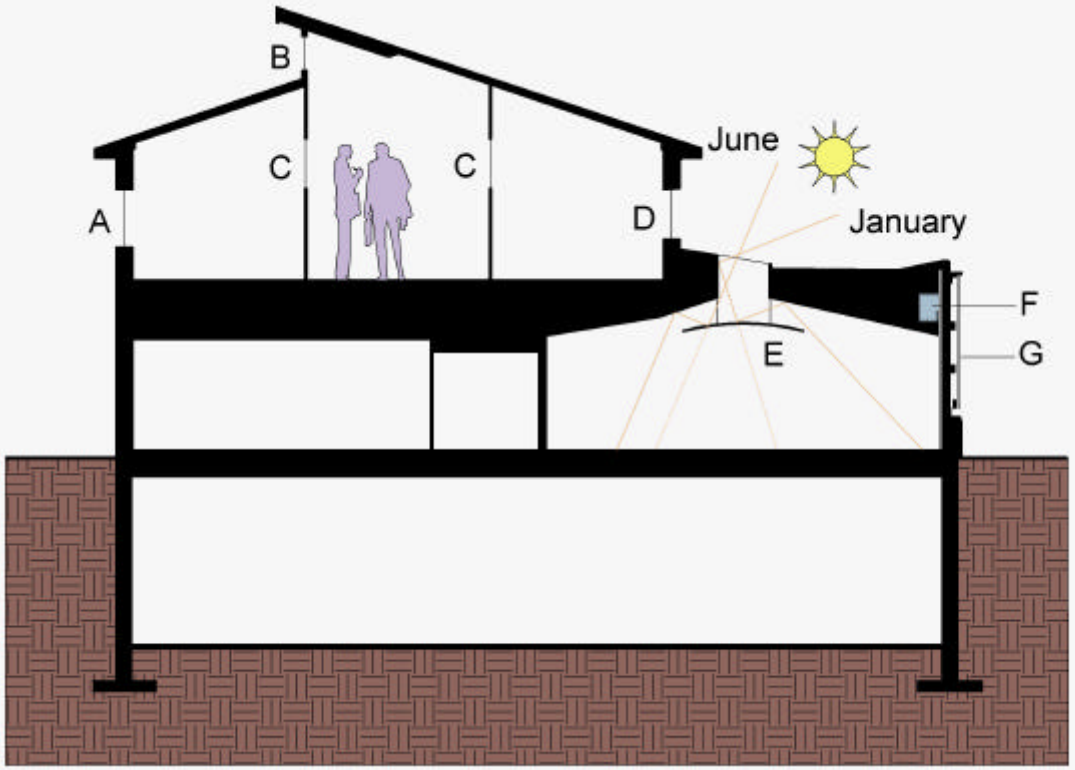

Section Through Classrooms

A. North light through window
B. North light through clerestory
C. Daylight sharing through interior glazing
D. South light through window
E. Diffuse south light though skylight and daylight deflector
F. Air intake for solar panel wall system
G. Solar panel wall system

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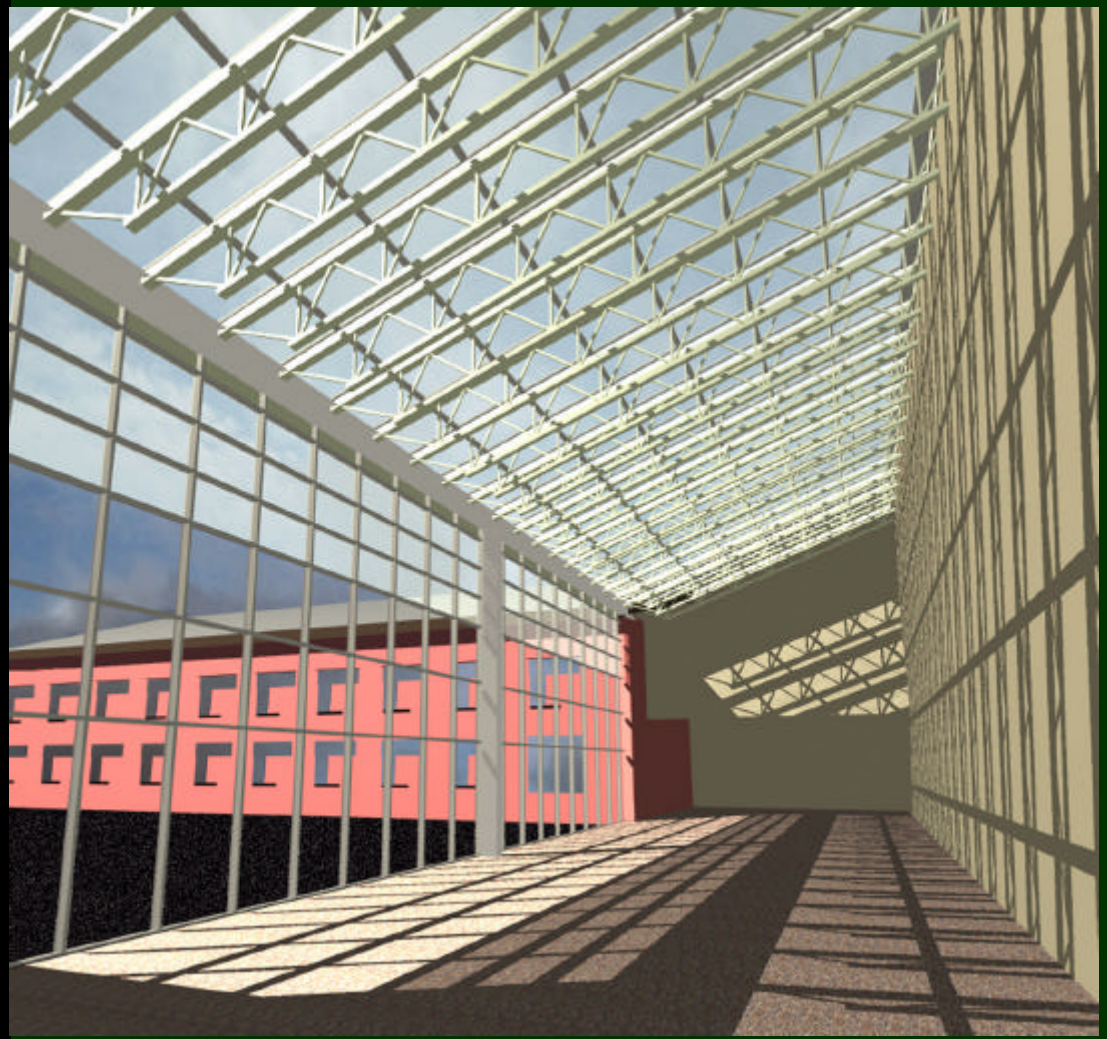

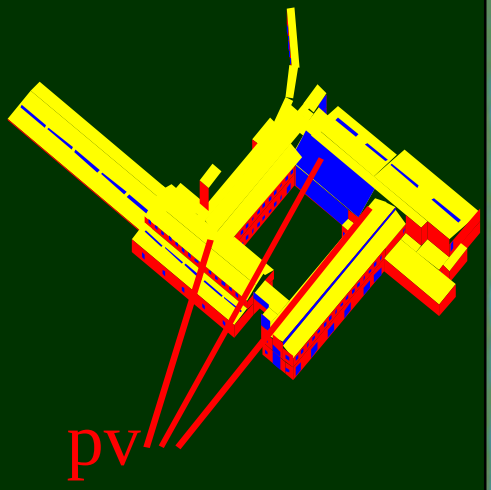

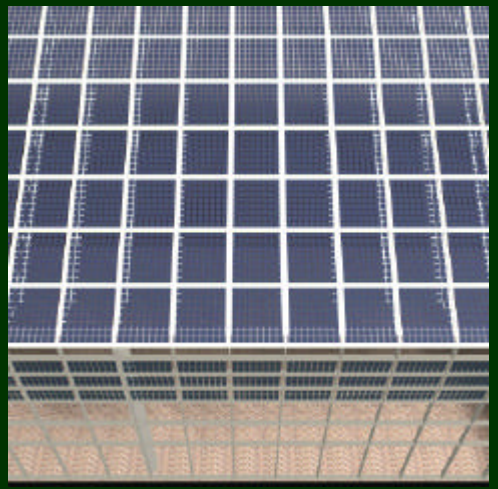

Performance Scorecard

• Energy savings		45%
• Water savings	10%	
• Materials Selection	A+	
• IAQ	A+	
• Renewable energy production	6%	

New Main Science Building

- Bid October 2000
- 75,000GSF classroom, lab and faculty office building
- $13.4 million
- $178/SF

Key Energy Strategy Components

- 3 angstrom sieve heat wheel for all exhaust
- Maximum use of daylighting
- Operable windows
- CO2 sensors for classrooms
- Displacement ventilation in public areas
- Occupancy sensors for all spaces

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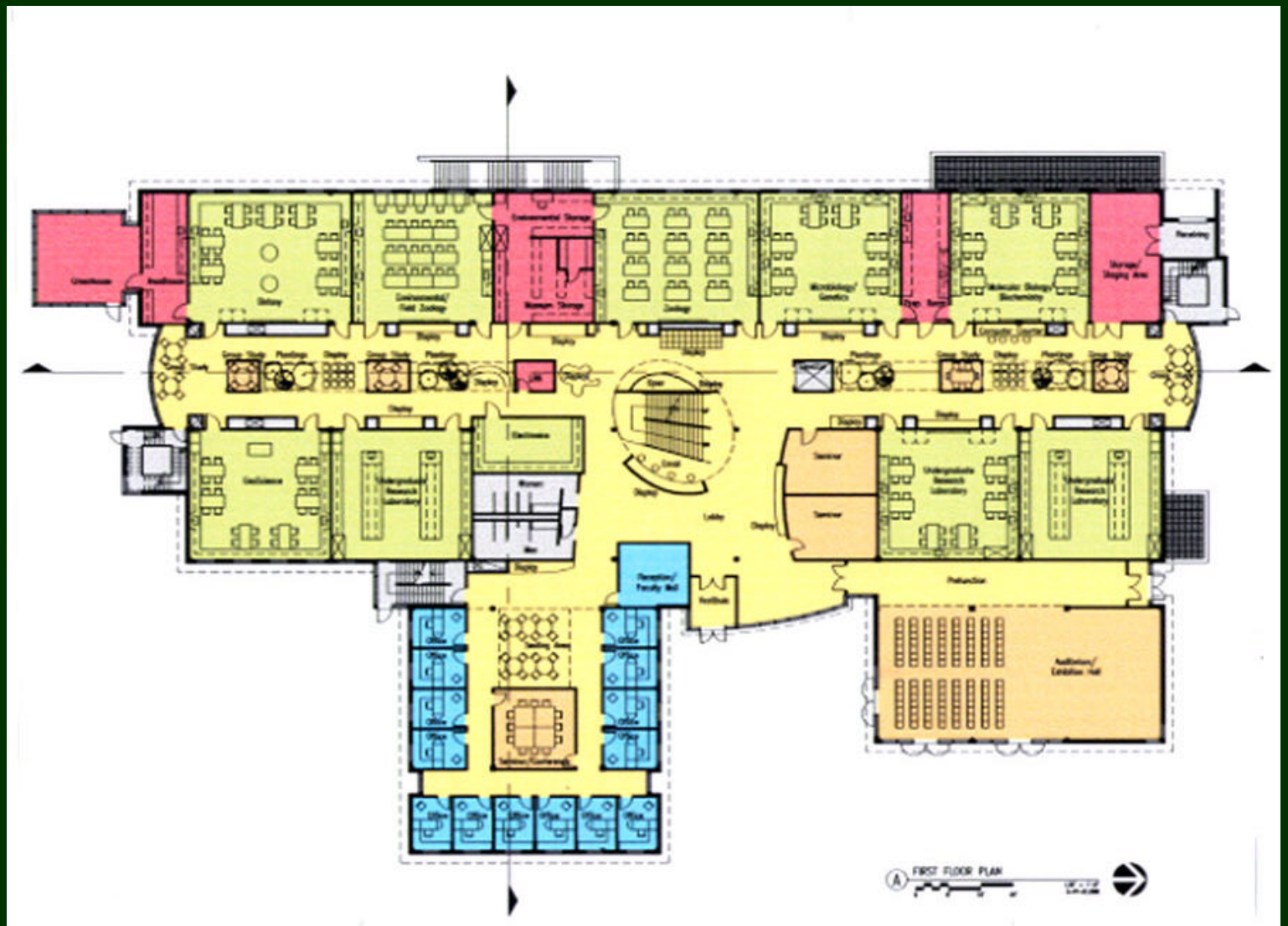

Drury College

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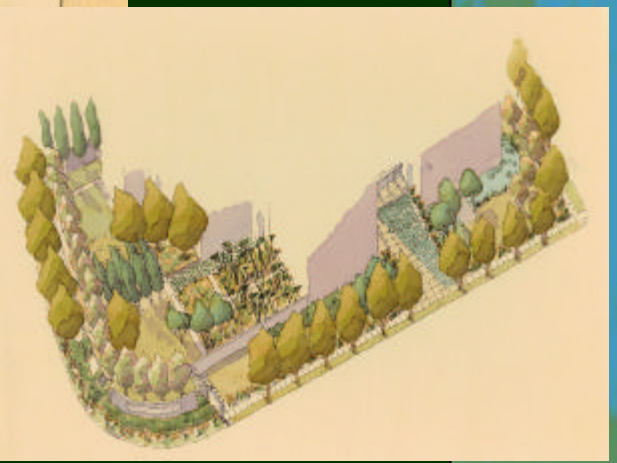

Performance Scorecard

- Energy savings 60%
- Water savings 40%
  (no flow off site)
- Materials Selection A+++
- IAQ A+++
- Environmental aspects demonstrated throughout

Overall Lessons Learned

What doesn't work

1. "Traditional" linear design process
2. Engineering separated from design
3. Overly complicated systems
4. Some technologies

Overall Lessons Learned

What does work

1. Integrated design process
2. Energy budget - know benchmarks
3. Importance of energy modeling
4. Opportunities even in fast track project
5. Opportunities in low budget projects
   - "low cost green"
6. Importance of follow up /follow through support

Questions